Remarks

The foregoing amendment is hereby submitted for the Examiner's consideration to comply with the objections or requirement of form expressly set forth in the Office Action, and to better place the present application in condition for allowance, in accordance with 37 C.F.R. § 1.116(a).

Upon entry of the foregoing amendment, claims 1-51 are pending in the application, with claims 1, 6, 9, 14, 20, 45, and 49 being the independent claims. Claims 1, 2, 4, 5, 9, 10, 12-15, 17-20, 22-24, 28-30, 34-36, and 40-42 are sought to be amended to correct typographical errors or other informalities. New claims 45-51 are sought to be added. Support for these changes can be found throughout the specification, including, inter alia, pages 18-21 of the written description and FIGs. 4A-9 of the drawings. These changes are believed to introduce no new matter, and their entry is respectfully requested.

Based on the above amendment and the following remarks, Applicants respectfully request that the Examiner reconsider all outstanding objections and rejections and that they be withdrawn.

Request for Corrected Non-Final Office Action

Referring to the Advisory Action dated April 11, 2005, (Paper No. 040705) and the Final Office Action dated November 10, 1004 (Paper No. 110104), claims 6, 9, 14, and 15 stand rejected. However, the Examiner has provided no ground for rejecting any of these claims. Applicants are unable to respond to an incomplete rejection. It is unclear whether claims 6, 9, 14, and 15 are allowable and the Examiner unintentionally rejected

the claims, or whether the rejection is intentional and the Examiner inadvertently neglected to state a ground for rejection. As such, Applicants respectfully request the Examiner to issue a Corrected Non-Final Office Action that explicitly states a ground of rejection, or explicitly indicates the claims are allowed.

Information Disclosure Statement

In a previous Office Action, the Examiner objected to an Information Disclosure Statement (IDS) filed 02 July 2003, but the Examiner made no reference to the 02 July 2003 IDS in a following Advisory Action. (See Paper No. 040705, page 2, and Paper No. 110104, page 2). Applicants have no record of submitting an IDS on 02 July 2003. The only IDS submitted, to date, was filed on 19 February 2002, and the Examiner considered the IDS on 20 August 2002, as indicated by the Examiner's signature on the PTO Form-1449 that accompanied the 19 February 2002 IDS. Therefore, Applicants consider this objection to have been made in error and withdrawn since the objection has not been repeated in the Advisory Action.

Claim Objections

In a previous Office Action, the Examiner objected to claim 37, but made no reference to the claim objection in a following Advisory Action. (See Paper No. 040705, page 2, and Paper No. 110104, page 2). Applicants consider this objection to have been overcome by the Amendment and Reply filed on 10 February 2005 since the objection has not been repeated in the Advisory Action.

Atty. Dkt. No. 910.00/(1452.3010000)

- 17 -

STEPHENSON *et al.*
Appl. No. 09/560,555

Rejections under 35 U.S.C. § 112

In a previous Office Action, the Examiner rejected claim 17-19 under 35 U.S.C.

§ 112, second paragraph, as allegedly being indefinite, but made no reference to the

rejection in a following Advisory Action. (See Paper No. 040705, page 2, and Paper No.

110104, pages 2-3). Applicants consider this rejection to have been overcome by the

Amendment and Reply filed on 10 February 2005 since the rejection has not been

repeated in the Advisory Action.

Rejections under 35 U.S.C. § 103

In the Final Office Action dated November 10, 1004, the Examiner sustained the

rejection of claims 1-44 under 35 U.S.C. § 103 as allegedly being unpatentable over a

combination of the following documents:

      a) U.S. Patent 6,209,004 to Bortnikov et al. (herein referred to as "Bortnikov");

      b) U.S. Patent 6,139,200 to Goebel (herein referred to as "Goebel");

      c) U.S. Patent 4,656,582 to Chaitin et al. (herein referred to as "Chaitin"); and

      c) U.S. Patent 5,347,654 to Sabot et al. (herein referred to as "Sabot"). (See Paper No. 040705, page 2, and Paper No. 110104, pages 3-10)

Applicants respectfully traverse. Each rejection is discussed separately below.

A.   Rejection of Claims 1 and 20-44

In the Final Office Action, the Examiner rejected claims 1 and 20-44 under 35

U.S.C. § 103(a) as allegedly being unpatentable over Bortnikov in view of Goebel. (See

Paper No. 040705, page 2, and Paper No. 110104, page 3). However, Bortnikov and

Goebel, taken alone or in combination, do not teach or suggest each and every element

and/or feature of claims 1 and 20-44. The Examiner's rejection of each claim is

discussed in greater detail below.

1.   *Independent Claim 1*

Independent claim 1 recites:

> A method for precise feedback data generation and
> updating during compile-time optimizations, within an
> optimizing compiler, comprising:
> (a)   accessing a first intermediate representation of
> source code of a computer program, wherein said first
> intermediate representation includes instructions
> instrumented into the source code of said computer
> program;
> (b)   annotating said first intermediate representation
> with previously-gathered frequency data from a plurality of
> sample executions of said computer program;
> (c)   updating said frequency data to maintain accuracy
> of said frequency data during compilation in a direction of
> increasing exactness;
> (d)   performing an optimization of said first
> intermediate representation annotated with said frequency
> data updated in step (c), thereby producing a transformed
> intermediate representation; and
> (e)   repeating steps (c) and (d) at least once during the
> same compilation pass.

In the Final Office Action dated November 10, 2004, the Examiner asserted that

Bortnikov allegedly discloses parts of steps (a)-(d) as recited in claim 1, but concedes

that Bortnikov does not disclose step (e). (Paper No. 110104, page 4). The Examiner

also conceded that Bortnikov does not disclose "updating frequency data to maintain

accuracy of said frequency data during compilation in a direction of increasing

exactness" as recited in step (c) of claim 1. (Paper No. 110104, page 4). The Examiner

further asserted that Goebel allegedly discloses the "use of feedback updates of

increasing exactness for reiterative optimization," and provides motivation to

"implement the optimizing compiler of Bortnikov with single pass optimization

refinement techniques as found in Goebel's teaching." (Paper No. 110104, page 4).

Applicants' respectfully traverse.

Bortnikov does not teach or suggest, alone or in combination with the other cited

documents, "updating said frequency data to maintain accuracy of said frequency data

during compilation in a direction of increasing exactness" as recited in step (c).

Moreover, contrary to the Examiner's assertions, Bortnikov does not teach or suggest

"updating said frequency data." In the Advisory Action dated April 11, 2005, the

Examiner asserted that "Bortnikov is updating call graph [sic] through updating the

frequencies." (See Paper No. 040705, page 2). This assertion is also erroneous.

Referring to lines 23-44 at column 9, Bortnikov describes:

> Referring to FIG. 3, a method 300 for modular reordering of program portions in a computer program *begins by generating a global call graph* 126 (step 310). The *global call graph 126 is generated from profile data that estimates the execution frequency for procedures* within computer program 122. As discussed above, this profile data may be statically or dynamically generated, and may be appropriately weighted to arrive at the estimates of execution frequencies. Method 300 then generates an intramodular call graph 222 for each module (step 320), and reorders the procedures within each module (step 330). Note that the reordering within each module respects the module boundaries. This assures that if a module needs to be replaced due to an enhancement or bug fix, it may be replaced without affecting procedures in other modules.
>
> Method 300 then generates an intermodular call graph 234 (step 340), *and reorders the modules within the computer program* (step 350). The reordering of modules preferably includes all modules in the computer program in the preferred embodiment, but reordering fewer than all modules is also anticipated by the present invention. (Emphasis added).

As described above, Bortnikov discloses the "generation of a call graph." As the

call graph is being generated, the call graph is populated with "estimates" of the

"execution frequency for procedures within" a computer program. At this point in the

disclosed method, no action has taken place to necessitate the "updating" of "previously-

gathered frequency data." The call graph is being generated for the first time, and the call

graph is being populated with "estimates" for the first time. Bortnikov does not teach or

suggest the performance of any activity that would alter the "estimates" and/or degrade

the accuracy or exactness of the "estimates." In fact referring to FIGs. 4-6, the weights

on the arcs in Bortnikov's call graph are the same values preceding and following the

optimization of the computer program. Therefore even if Bortnikov discloses Applicants'

step (b) of "annotating said first intermediate representation with previously-gathered

frequency data from a plurality of sample executions of said computer program" (which

Applicants do not concede), Bortnikov does not teach or suggest "updating said

frequency data" as recited in Applicants' step (c) of claim 1.

Goebel fails to cure the deficiencies of Bortnikov since Goebel also does not

teach or suggest, alone or in combination with the other cited documents, "updating said

frequency data to maintain accuracy of said frequency data during compilation in a

direction of increasing exactness" as recited in step (c). In the Office Action dated

November 10, 2004, the Examiner asserted that Goebel allegedly discloses the use of

"feedback updates of increasing exactness for reiterative optimization." Applicants

respectfully disagree.

Goebel does not teach or suggest that its "feedback" data is updated. Referring to

lines 31-52 at column 9, Goebel describes:

> In step 520, code optimizations are generated for the region of code...
>
> In step 530, physical registers are allocated with respect to the region of code...
>
> At step 540, feedback is generated based on the allocation of registers in step 530. The *feedback includes* data useful to adjusting the generation of code optimizations. Such data includes *the number of virtual registers spilled and the number of instructions re-arranged.* The feedback can also include the data representing the register interference graph, which indicates the number of connections for each node.
>
> In this example, the feedback information would indicate that node c, 1, m, x, and y have two connections after the nodes with less than two connections have been removed (i.e. the number of physical registers). Thus at least one variable requires spilling.
>
> At step 550, a *determination is made of whether the code optimizations meet efficiency criteria.* The criteria include the application of *such factors as the number of variables that may be spilled, the number of instructions being performed in parallel, whether the spills are occurring in a sequence of instructions expected to be frequently executed (e.g. instructions within a loop), and whether the code optimizations optimize the performance of a sequence of executable code expected to be frequently executed (e.g. instructions within a loop).*
>
> In this example, as result of the generated code optimizations, executable code represented by code 214 and code 216 can be performed in parallel with the executable code represented by code 212. However, the code does not lie within a loop. Performing three instructions in parallel outside of a loop at the expense of spilling one variable fails, for the purposes of this example, fails to meet efficiency criteria. Therefore control passes to step 560. (Emphasis added).

As described above, Goebel discloses the generation of "feedback data" that is

utilized to determine if "code optimizations meet efficiency criteria." The method

disclosed by Goebel determines the "number of virtual registers spilled and the number

of instructions re-arranged" and compares this data with "efficiency criteria" established

for "the number of variables that may be spilled" and "the number of instructions being

performed in parallel." Although Goebel's disclosed method also considers "whether

the spills are occurring in a sequence of instructions *expected to be frequently executed*

(e.g. instructions within a loop), and whether the code optimizations optimize the

performance of a sequence of executable code expected to be frequently executed (e.g.

instructions within a loop)," Goebel does not teach or suggest the "updating" of any

frequency data.

On the contrary, Goebel discloses a "feedback mechanism" for "allocating

registers and performing code optimizations" to determine whether "a number of virtual

registers subject to spilling [exceeds] a threshold number [i.e., the number of available

physical registers]". (See column 2, lines 7-13, column 8, lines 30-32, and column 11,

lines 1-6). Therefore, even if Goebel's "register interference graph" can be considered as

being an "intermediate representation" and/or even if Goebel's "number of virtual

registers subject to spilling" can be considered as being "frequency data" (neither of

which Applicants concede), Goebel does not teach or suggest "annotating [a register

interference graph] with previously-gathered [feedback data, such as the number of

virtual registers subject to spilling] from a plurality of sample executions of said

computer program," as recited in Applicants' claim 1. On the contrary, Goebel discloses

that the "number of virtual registers subject to spilling" is determined from the "register

interference graph," rather than the "register interference graph" being annotated with the

"number of virtual registers." (See column 9, lines 35-37).

Furthermore, even if Goebel discloses "annotating [a register interference graph

or any other intermediate representation] with previously-gathered [feedback data, such

as the number of virtual registers subject to spilling] from a plurality of sample

executions of said computer program," (which Applicants do not concede), Goebel does

not teach or suggest "updating said frequency data to maintain accuracy of said

frequency data during compilation in a direction of increasing exactness," as recited in

Applicants' claim 1. Goebel's "feedback" data (e.g., the "number of virtual registers

subject to spilling") is "generated based on the allocation of registers" (see column 9,

lines 31-32). Goebel does not teach or suggest the performance of any activity that would

alter the "feedback" data and/or degrade the accuracy or exactness of the "feedback"

data. Therefore, Goebel provides no motivation or suggestion to update its "feedback"

data. Moreover, Goebel does not teach or suggest that its "feedback" data is annotated at

any place within an intermediate representation that would require the feedback data to

be updated.

For at least the reasons stated above, Applicants respectfully request

reconsideration and withdrawal of the rejection of claim 1, and allowance thereof.

Claims 2-5 and 21-26 depend from claim 1, directly or indirectly. Thus, these

claims are patentable for at least the reasons provided above with respect to claim 1, in

addition to the features recited therein. Applicants, therefore, respectfully request

reconsideration and withdrawal of the rejection of claims 2-5 and 21-26, and allowance

thereof.

- 24 -

STEPHENSON *et al.*
Appl. No. 09/560,555

2. *Independent Claim 20*

In the Final Office Action, the Examiner stated that the limitations of claim 20 are substantially similar to claim 1, and as such, rejected claim 20 in the same manner. (Paper No. 110104, page 4).

Claim 20 includes features that are similar to claim 1, with additional features relating to annotating and updating "estimated frequency data." As presented above, neither Bortnikov nor Goebel, alone or in combination, teaches or suggests "updating said frequency data to maintain accuracy of said frequency data during compilation in a direction of increasing exactness," as recited in claim 1. Thus for at least the reasons provided above with respect to claim 1, neither Bortnikov nor Goebel, alone or in combination, teaches or suggests "updating *the estimated frequency* data to maintain accuracy of said frequency data during compilation in a direction of increasing exactness," as recited in claim 20.

For at least these reasons, Applicants respectfully request reconsideration and withdrawal of the rejection of claim 20, and allowance thereof.

3. *Claims 27-44*

In the Final Office Action, the Examiner has rejected claims 27-44. (Paper No. 110104, page 6). However, claims 27-32 depend from independent claim 6; claims 33-36, 38, and 39 depend from independent claim 9; and claims 37 and 40-44 depend from independent claim 14. As discussed above, Applicants are unable to determine whether claims 6, 9, and 14 are allowed or rejected. Since claims 27-44 depend from claims 6, 9, and 14, these dependent claims should be allowable if claims 6, 9, and 14 are allowable.

Atty. Dkt. No. 910.00/(1452.3010000)

At present since the rejection of claims 6, 9, and 14 are incomplete, Applicants are

unable to respond to the rejection of claims 27-44. As such, Applicants respectfully

request the Examiner to issue a Corrected Non-Final Office Action that explicitly states a

ground for rejecting claims 6, 9, and 14, or explicitly indicates claims 6, 9, 14, and 27-44

are allowed.

B.   *Rejection of Claims 2 and 10*

In the Office Action, the Examiner rejects claims 2 and 10 under 35 U.S.C.

§ 103(a) as being unpatentable over Bortnikov in view of Goebel, and in further view of

Chaitin. (See Paper No. 040705, page 2, and Paper No. 110104, page 7). However,

Bortnikov, Goebel, and Chaitin, taken alone or in combination, do not teach or suggest

each and every element and/or feature of claims 2 and 10. The Examiner's rejection of

each claim is discussed in greater detail below.

1.   *Claim 2*

Claim 2 depends from claim 1. Therefore, claim 2 is patentable over Bortnikov

and/or Goebel for at least the reasons provided above with respect to the rejection of

claim 1, in addition to the features recited in claim 2. Furthermore, Chaitin fails to cure

the deficiencies of Bortnikov and Goebel since Chaitin also does not teach or suggest

"updating said frequency data to maintain accuracy of said frequency data during

compilation in a direction of increasing exactness," as recited in Applicants' claim 1.

For at least these reasons, Applicants respectfully request reconsideration and

withdrawal of the rejection of claim 2, and allowance thereof.

2. Claim 10

Claim 10 depends from claim 9. As discussed above, Applicants are unable to determine whether claim 9 is allowed or rejected. Since claim 10 depends from claim 9, claim 10 should be allowable if claim 9 is allowable. At present since the rejection of claim 9 is incomplete, Applicants are unable to respond to the rejection of claim 10. As such, Applicants respectfully request the Examiner to issue a Corrected Non-Final Office Action that explicitly states a ground for rejecting claim 9, or explicitly indicates claims 9 and 10 are allowed.

C. Rejection of Claims 3-5, 7, 8, 11-13, and 16-19

In the present case, the Examiner rejects claims 3-5, 7, 8, 11-13, and 16-19 under 35 U.S.C. § 103(a) as being un-patentable over Bortnikov in view of Goebel, and in further view of Sabot. (See Paper No. 040705, page 2, and Paper No. 110104, page 8). However, Bortnikov, Goebel, and Sabot, taken alone or in combination, do not teach or suggest each and every element and/or feature of claims 3-5, 7, 8, 11-13, and 16-19. The Examiner's rejection of each claim is discussed in greater detail below.

1. Claims 3-5

Claims 3-5 depend directly or indirectly from claim 1. Therefore, claims 3-5 are patentable over Bortnikov and/or Goebel for at least the reasons provided above with respect to the rejection of claim 1.

Furthermore, Sabot fails to cure the deficiencies of Bortnikov and Goebel since Sabot also does not teach or suggest "updating said frequency data to maintain accuracy of said frequency data during compilation in a direction of increasing exactness," as recited in Applicants' claim 1.

For at least these reasons, Applicants respectfully request reconsideration and withdrawal of the rejection of claims 3-5, and allowance thereof.

2.   *Claims 7 and 8*

Claims 7 and 8 depend directly or indirectly from claim 6. As discussed above, Applicants are unable to determine whether claim 6 is allowed or rejected. Since claims 7 and 8 depend from claim 6, these dependent claims should be allowable if claim 6 is allowable. At present since the rejection of claim 6 is incomplete, Applicants are unable to respond to the rejection of claims 7 and 8. As such, Applicants respectfully request the Examiner to issue a Corrected Non-Final Office Action that explicitly states a ground for rejecting claim 6, or explicitly indicates claims 6-8 are allowed.

3.   *Claims 11-13*

Claims 11-13 depend directly or indirectly from claim 9. As discussed above, Applicants are unable to determine whether claim 9 is allowed or rejected. Since claims 11-13 depend from claim 9, these dependent claims should be allowable if claim 9 is allowable. At present since the rejection of claim 9 is incomplete, Applicants are unable to respond to the rejection of claims 11-13. As such, Applicants respectfully request the

Examiner to issue a Corrected Non-Final Office Action that explicitly states a ground for

rejecting claim 9, or explicitly indicates claims 9 and 11-13 are allowed.

4.   Claims 16-19

Claims 16-19 depend directly or indirectly from claim 14. As discussed above,

Applicants are unable to determine whether claim 9 is allowed or rejected. Since claims

16-19 depend from claim 14, these dependent claims should be allowable if claim 14 is

allowable. At present since the rejection of claim 14 is incomplete, Applicants are

unable to respond to the rejection of claims 16-19. As such, Applicants respectfully

request the Examiner to issue a Corrected Non-Final Office Action that explicitly states a

ground for rejecting claim 14, or explicitly indicates claims 14 and 16-19 are allowed.

D.   New Claims 45-51

New claims 45-51 are sought to be added to recite further features that are not

taught or suggested by Bortnikov, Goebel, Chaitin, and Sabot, taken alone or in

combination with each other. Applicants respectfully request consideration and

allowance of these claims.

Conclusion

All of the stated grounds of objection and rejection have been properly traversed,

accommodated, or rendered moot. Applicants therefore respectfully request that the

Examiner reconsider all presently outstanding objections and rejections and that they be

Atty. Dkt. No. 910.00/(1452.3010000)

withdrawn. Applicants believe that a full and complete reply has been made to the

outstanding Office Action and, as such, the present application is in condition for

allowance. If the Examiner believes, for any reason, that personal communication will

expedite prosecution of this application, the Examiner is invited to telephone the

undersigned at the number provided.

Prompt and favorable consideration of this Amendment and Reply is respectfully

requested.

Respectfully submitted,

STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.

Kendrick P. Patterson
Attorney for Applicants
Registration No. 45,321

Date: ___October 11, 2005_____

1100 New York Avenue, N.W.
Washington, D.C. 20005-3934
(202) 371-2600

452219_1.DOC